

**Marking, Enumeration, and Size Estimation for
Coho and Chinook Salmon Smolt Releases into
Upper Cook Inlet, Resurrection Bay and Prince
William Sound, Alaska, 2001-2003**

by

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and

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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Weights and measures (metric)		General		Measures (fisheries)	
centimeter	cm	Alaska Administrative Code	AAC	fork length	FL
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	mid-eye-to-fork	MEF
gram	g	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	mid-eye-to-tail-fork	METF
hectare	ha	at	@	standard length	SL
kilogram	kg	compass directions:		total length	TL
kilometer	km	east	E	Mathematics, statistics <i>all standard mathematical signs, symbols and abbreviations</i>	
liter	L	north	N		
meter	m	south	S		
milliliter	mL	west	W	alternate hypothesis	H _A
millimeter	mm	copyright	©	base of natural logarithm	e
Weights and measures (English)		corporate suffixes:		catch per unit effort	CPUE
cubic feet per second	ft ³ /s	Company	Co.	coefficient of variation	CV
foot	ft	Corporation	Corp.	common test statistics etc.)	(F, t, χ^2 ,
gallon	gal	Incorporated	Inc.	confidence interval	CI
inch	in	Limited	Ltd.	correlation coefficient (multiple)	R
mile	mi	District of Columbia	D.C.	correlation coefficient (simple)	r
nautical mile	nmi	et alii (and others)	et al.	covariance	cov
ounce	oz	et cetera (and so forth)	etc.	degree (angular)	°
pound	lb	exempli gratia		degrees of freedom	df
quart	qt	(for example)	e.g.	expected value	E
yard	yd	Federal Information Code	FIC	greater than	>
Time and temperature		id est (that is)	i.e.	greater than or equal to	≥
day	d	latitude or longitude	lat. or long.	harvest per unit effort	HPUE
degrees Celsius	°C	monetary symbols		less than	<
degrees Fahrenheit	°F	(U.S.)	\$, ¢	less than or equal to	≤
degrees kelvin	K	months (tables and figures): first three letters	Jan.,...,Dec	logarithm (natural)	ln
hour	h	registered trademark	®	logarithm (base 10)	log
minute	min	trademark	™	logarithm (specify base)	log ₂ , etc.
second	s	United States (adjective)	U.S.	minute (angular)	'
Physics and chemistry		United States of America (noun)	USA	not significant	NS
all atomic symbols		U.S.C.	United States Code	null hypothesis	H ₀
alternating current	AC	U.S. state	use two-letter abbreviations (e.g., AK, WA)	percent	%
ampere	A			probability	P
calorie	cal			probability of a type I error (rejection of the null hypothesis when true)	α
direct current	DC			probability of a type II error (acceptance of the null hypothesis when false)	β
hertz	Hz			second (angular)	"
horsepower	hp			standard deviation	SD
hydrogen ion activity (negative log of)	pH			standard error	SE
parts per million	ppm			variance	
parts per thousand	ppt, ‰			population	Var
volts	V			sample	var
watts	W				

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ABSTRACT

Approximately 904,000 coho salmon *Oncorhynchus kisutch* and 1.6 million Chinook salmon *O. tshawytscha* smolt were released at locations in Cook Inlet, Resurrection Bay and Prince William Sound in 2001. Of these, about 171,000 coho salmon and 493,000 Chinook salmon were released with an adipose finclip and coded wire tag. In 2002, approximately 852,000 coho salmon and 1.6 million Chinook salmon smolt were released at locations in Cook Inlet, Prince William Sound, and Resurrection Bay. Each released smolt was thermally marked to identify the area of release, and in some cases, the specific release site. Of these, about 174,000 coho salmon and 476,000 Chinook salmon were released with adipose clips and coded wire tags. In 2003, approximately 905,000 coho salmon and 1.8 million Chinook salmon smolt were released at locations in Cook Inlet, Prince William Sound, and Resurrection Bay. Each released smolt was thermally marked to identify the area of release. Of these, about 64,000 coho salmon and 238,000 Chinook salmon were released with adipose clips and coded wire tags.

In 2001, tag retention for individual release groups ranged from 96.1% to 99.6%; in 2002 the range was 93.7% to 99.6%; and in 2003 from 92.4% to 99.8%. In all years, only a few release groups were within the production goal of 80% of smolts within the size range of 5.1 g to 15.0 g for Chinook salmon and 80% of the coho salmon within the 15.1 g to 25 g size range. However, many release groups came close to the production goal.

Key words: hatchery, marking, coded wire tags, thermal mark, Chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, tag retention, size composition.

INTRODUCTION

Over half of Alaskans live in Southcentral Alaska, which receives the vast majority of the state's sport fishing effort. Chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* smolt reared at Fort Richardson Hatchery (FRH) and Elmendorf Hatchery (EH) have been stocked in numerous locations throughout Southcentral Alaska to improve or create terminal sport fisheries and relieve pressure on wild stocks (Appendices A1 and A2). A critical element of many of these smolt stocking projects in Cook Inlet, Prince William Sound, and Resurrection Bay is the use of coded wire tags (CWT) in conjunction with adipose finclips, and in 2002 and 2003 thermal marks (TM), as a means to identify stocked fish. TMs and CWTs may be used to estimate the contribution from individual stockings to commercial fisheries, marine and freshwater recreational fisheries, and personal use fisheries; estimate spawning escapement in stocked streams; and evaluate straying of stocked coho and Chinook salmon.

The accuracy of contribution estimates from CWT recoveries is highly dependent upon the accuracy of the estimated number of unmarked fish in the release population. Determining the number of unmarked fish is not an issue when TMs are used because all fish are marked. However, determining the number of fish in each release group is still necessary. Three techniques are used at FRH and EH for determining the number of unmarked fish and/or total number of fish released: physical counts, hatchery inventory estimates, and water volume displacement.

Another important element of hatchery smolt stocking programs is fish size. Mean weight and length distribution at release are indicators of the quality of hatchery smolt (Peltz and Starkey 1993). If smolt are too small at release, ocean survival will be poor; if smolt are too large at release, ocean residence will be reduced, shifting age composition of returns to younger, smaller fish (Sweet and Peltz 1994). To maximize ocean survival and maintain the age composition of the population, Peltz and Starkey (1993) recommended that 80% of hatchery coho smolt weigh between 15.1 and 25.0 g, and hatchery Chinook

salmon weigh between 5.1 and 15.0 g at release. Weight distributions at release allow hatchery personnel to determine the quality of smolt being released.

This project documents hatchery releases and marking of Chinook and coho salmon in Cook Inlet, Prince William Sound, and Resurrection Bay.

In 2001-2003, objectives were:

1. To estimate the weight composition of each release group;
2. To estimate the long-term (>30 days) tag retention rate of each release group containing fish with CWTs.

In 2001 and 2002, we planned to mark with an adipose clip and CWT a representative sample of at least 20,000 coho salmon from one release group, and at least 40,000 coho or Chinook salmon from nine other release groups. In 2003, we planned to mark with an adipose clip and CWT a representative sample of at least 40,000 coho or Chinook salmon smolt from four release groups.

In 2002 and 2003, an additional objective was:

3. To identify the actual thermal mark applied to the otoliths of fish in each release group of coho and Chinook salmon.

This report presents the results of the 2001-2003 marking programs. Based on the data summarized in this report, recommendations are made for future marking and collection of release data. All data for this report are held and archived by Research and Technical Services (RTS), Sport Fish Division, Alaska Department of Fish and Game (ADF&G).

METHODS

In 2001, EH raised Chinook salmon from Crooked Creek, Ninilchik River, Ship Creek, and Deception Creek broodstocks. In 2002, Crooked Creek, Ship Creek, and Ninilchik River were the broodstocks for Chinook salmon raised at EH (Tables 1 and 2). There were no anadromous fish releases from EH in 2003.

At FRH in 2001 and 2002, coho salmon were from Ship Creek (Little Susitna River), Bear Lake, and Eklutna Tailrace (Jim Creek) broodstocks, and Chinook salmon were from Deception Creek and Ninilchik River broodstocks (Tables 1 and 2). In 2003, Bear Lake, Ship Creek (Little Susitna River), and Eklutna Tailrace (Jim Creek) were the broodstocks for coho salmon raised at FRH; and Deception Creek, Ship Creek, Crooked Creek, and Ninilchik River were the broodstocks for Chinook salmon (Table 3).

In 2001, fish from 19 release groups were released at 9 sites in Cook Inlet, 2 sites in Resurrection Bay, and 3 sites in Prince William Sound (Table 1). In 2002, fish from 20 release groups were released at 9 sites in Cook Inlet, 3 sites in Prince William Sound, and 2 sites in Resurrection Bay (Table 2). In 2003, fish from 19 release groups were released at 9 sites in Cook Inlet, 2 sites in Resurrection Bay and 3 sites in Prince William Sound (Table 3).

SMOLT MARKING

Smolt released in 2001 were marked with CWTs only. All 2002 and 2003 smolt release groups were marked with TMs, and some were also marked with CWTs.

Table 1.-Number of Chinook and coho salmon stocked into various systems of Cook Inlet, Resurrection Bay and Prince William Sound, 2001.

Stocking Site	Area	Broodstock	Number of Fish Released	Enumeration Method Used	Number of Raceways
Elmendorf Hatchery					
<u>Chinook Salmon</u>					
Crooked Creek	Cook Inlet	Crooked Creek	109,201	physical count	1
Lowell Creek	Resurrection Bay	Crooked Creek	114,748	hatchery inventory	1
Seward Lagoon	Resurrection Bay	Crooked Creek	113,147	hatchery inventory	1
Halibut Cove	Cook Inlet	Ninilchik River	106,719	hatchery inventory	1
Seldovia	Cook Inlet	Ninilchik River	102,793	hatchery inventory	1
Homer Spit	Cook Inlet	Ninilchik River	106,263	hatchery inventory	2
			101,799		
Ship Creek	Cook Inlet	Ship Creek	85,247	hatchery inventory	3
			84,716	hatchery inventory	
			84,961	hatchery inventory	
Fleming Spit	Prince William Sound	Deception Creek	94,812	hatchery inventory	1
Valdez Harbor	Prince William Sound	Deception Creek	94,701	hatchery inventory	1
Whittier Harbor	Prince William Sound	Deception Creek	95,823	hatchery inventory	1
Subtotal			1,294,930		
Fort Richardson Hatchery					
<u>Coho Salmon</u>					
Campbell Creek	Cook Inlet	Ship Cr (Little Susitna River)	69,836	hatchery inventory	1
Ship Creek	Cook Inlet	Ship Cr (Little Susitna River)	117,198	hatchery inventory	2
			116,365	hatchery inventory	
Homer Spit	Cook Inlet	Ship Cr (Little Susitna River)	100,280	hatchery inventory	1
Homer Spit	Cook Inlet	Bear Lk	124,762	hatchery inventory	1
Eklutna Tailrace	Cook Inlet	Eklutna Tailrace (Jim Creek)	124,838	hatchery inventory	1
Lowell Creek	Resurrection Bay	Bear Lk	125,618	hatchery inventory	1
Seward Lagoon	Resurrection Bay	Bear Lk	<u>124,703</u>	hatchery inventory	1
Subtotal			903,600		
<u>Chinook Salmon</u>					
Deception Creek	Cook Inlet	Deception Creek	131,213	physical count	2
			76,252	physical count	
Ninilchik River	Cook Inlet	Ninilchik River	<u>54,770</u>	physical count	1
Subtotal			262,235		
Total			2,460,765		

Table 2.-Number of Chinook and coho salmon stocked into various systems in Cook Inlet, Prince William Sound, and Resurrection Bay, 2002.

Release Site	Area	Broodstock	Number of Fish Released	Enumeration Method Used	Number of Raceways
Elmendorf Hatchery					
<u>Chinook Salmon</u>					
Crooked Creek	Cook Inlet	Crooked Creek	99,547	physical count	1
Eklutna Tailrace	Cook Inlet	Ship Creek	106,991	volumetric	1
Halibut Cove	Cook Inlet	Ninilchik River	106,279	volumetric	1
Homer Spit	Cook Inlet	Ninilchik River	67,582	volumetric	2
			122,444	volumetric	
Lowell Creek	Resurrection Bay	Crooked Creek	93,296	volumetric	1
Seldovia	Cook Inlet	Ninilchik River	83,045	volumetric	1
Seward Lagoon	Resurrection Bay	Crooked Creek	100,314	volumetric	1
Ship Creek	Cook Inlet	Ship Creek	86,937	volumetric	3
			102,761	volumetric	
			100,803	volumetric	
Subtotal			1,069,999		
Fort Richardson Hatchery					
<u>Coho Salmon</u>					
Campbell Creek	Cook Inlet	Ship Cr (Little Susitna River)	61,323	hatchery inventory	1
Eklutna Tailrace	Cook Inlet	Eklutna Tailrace (Jim Creek)	120,629	hatchery inventory	1
Homer Spit	Cook Inlet	Ship Cr (Little Susitna River)	95,648	hatchery inventory	1
Homer Spit	Cook Inlet	Bear Lake	120,707	hatchery inventory	1
Lowell Creek	Resurrection Bay	Bear Lake	119,512	hatchery inventory	1
Seward Lagoon	Resurrection Bay	Bear Lake	121,743	hatchery inventory	1
Ship Creek	Cook Inlet	Ship Cr (Little Susitna River)	108,187	hatchery inventory	2
			104,452	hatchery inventory	
Subtotal			852,201		
<u>Chinook Salmon</u>					
Deception Creek	Cook Inlet	Deception Creek	125,857	physical count	2
			71,420	physical count	
Ninilchik River	Cook Inlet	Ninilchik River	54,631	physical count	1
Fleming Spit	Prince William Sound	Deception Creek	109,656	hatchery inventory	1
Valdez Harbor	Prince William Sound	Deception Creek	107,861	hatchery inventory	1
Whittier Harbor	Prince William Sound	Deception Creek	<u>109,763</u>	hatchery inventory	1
Subtotal			579,188		
Total			2,501,388		

Table 3.-Total number of Chinook and coho salmon stocked into various systems in Cook Inlet, Prince William Sound, and Resurrection Bay, 2003.

Release Site	Area	Broodstock	Number of Fish Released	Enumeration Method Used	Number of Raceways
Ft. Richardson					
<u>Coho Salmon</u>					
Campbell Creek	Cook Inlet	Ship Cr (Little Susitna River)	78,576	hatchery inventory	1
Eklutna Tailrace	Cook Inlet	Eklutna Tailrace (Jim Creek)	120,736	hatchery inventory	1
Homer Spit	Cook Inlet	Ship Cr (Little Susitna River)	119,596	hatchery inventory	2
			103,139	hatchery inventory	
Ship Creek	Cook Inlet	Ship Cr (Little Susitna River)	117,397	hatchery inventory	2
			117,319	hatchery inventory	
Lowell Creek	Resurrection Bay	Bear Lake	124,389	hatchery inventory	1
Seward Lagoon	Resurrection Bay	Bear Lake	123,718	hatchery inventory	1
Subtotal			904,870		
<u>Chinook Salmon</u>					
Crooked Creek	Cook Inlet	Crooked Creek	98,800	physical count	1
Deception Creek	Cook Inlet	Deception Creek	101,181	physical count	1
Eklutna Tailrace	Cook Inlet	Ship Creek	109,136	hatchery inventory	2
			109,356	hatchery inventory	
Halibut Cove	Cook Inlet	Ninilchik River	106,844	hatchery inventory	1
Homer Spit	Cook Inlet	Ninilchik River	126,229	hatchery inventory	2
			80,063	hatchery inventory	
Ninilchik River	Cook Inlet	Ninilchik River	47,997	physical count	1
Seldovia	Cook Inlet	Ninilchik River	107,521	hatchery inventory	1
Ship Creek	Cook Inlet	Ship Creek	109,816	hatchery inventory	3
			109,806	hatchery inventory	
			109,794	hatchery inventory	
Lowell Creek	Resurrection Bay	Crooked Creek	110,331	hatchery inventory	1
Seward Lagoon	Resurrection Bay	Crooked Creek	109,976	hatchery inventory	1
Fleming Spit	Prince William Sound	Deception Creek	109,757	hatchery inventory	1
Valdez Harbor	Prince William Sound	Deception Creek	109,661	hatchery inventory	1
Whittier Harbor	Prince William Sound	Deception Creek	109,700	hatchery inventory	1
Subtotal			1,765,968		
Total			2,670,838		

Coded Wire Tagging

For release groups that were to be marked with CWTs, one or more unique tag codes were used for each release group.

At EH in 2001, fish were systematically selected for tagging when they were divided into two raceways. In the splitting process, technicians crowded and held the fish at one end of the original raceway. All fish that were to be transferred to a new raceway were dipnetted, weighed, and either placed in net pens to be held for tagging, or released in the new raceway. Approximately every third to fifth dip net of fish was held for tagging; the proportion held for tagging was based on the number of fish to be tagged and the estimated number of fish in the raceway. Fish remaining in the original raceway were also netted, weighed, and then either placed into net pens for tagging or returned to the raceway on the other side of the crowder. After all fish in the raceway were weighed, the crowder was removed. All fish placed in the net pens were marked and tagged. At EH in 2002, there was one release group and all fish were tagged.

At FRH in all 3 years, we used a systematic sampling procedure to obtain a representative sample of smolt for marking from each release group where only a portion of the fish was to be tagged. For each rearing unit, fish were systematically removed and held separate from the rest of the population until they were tagged. In the sampling process, technicians crowded and held the fish at one end of the rearing unit. All fish were dipnetted, and approximately every third to fourth dip net of fish was weighed and placed in the area designated for fish to be tagged. Fish not selected for tagging were dipnetted and returned to the raceway on the other side of the crowder. All fish selected for tagging were adipose clipped and injected with a CWT. If fish for a particular release group were in more than one raceway, then an attempt was made to mark approximately the same proportion of fish in each raceway (Peltz and Miller 1990).

All fish were tagged with a full-length CWT (1.1 mm) using a Northwest Marine Technology¹ Mark IV tag injector. All of the tagged smolt were graded and tagged using the appropriate size head mold. At least 510 fish were obtained from each broodstock up to 7 days before the start of tagging. Each fish was measured for fork length to the nearest millimeter to estimate the length frequency distribution. The two or three head mold sizes that fit at least 80% of the length distribution were selected for tagging, and the fish were graded accordingly.

Fish that were to be tagged were anesthetized with MS-222. The adipose fin was excised at the base using surgical scissors. Tags were then injected into the noses of the fish, and the fish were sent through a Quality Control Device (QCD). The QCD detected the magnetized tag and separated the fish with tags from those without tags. All fish without tags were tagged again. Quality control checks for tag placement were conducted following initial daily startup, and following a change in head mold size or a change in tagging personnel. During each quality control check, a minimum of two tagged fish were dissected to determine tag placement (Moberly et al. 1977; Figure 1). Head mold or wire adjustments were made when necessary. The fish that were killed to determine tag placement were subtracted from the daily number of tagged fish and were not included as tagged fish.

¹ Use of a company's name does not constitute endorsement.

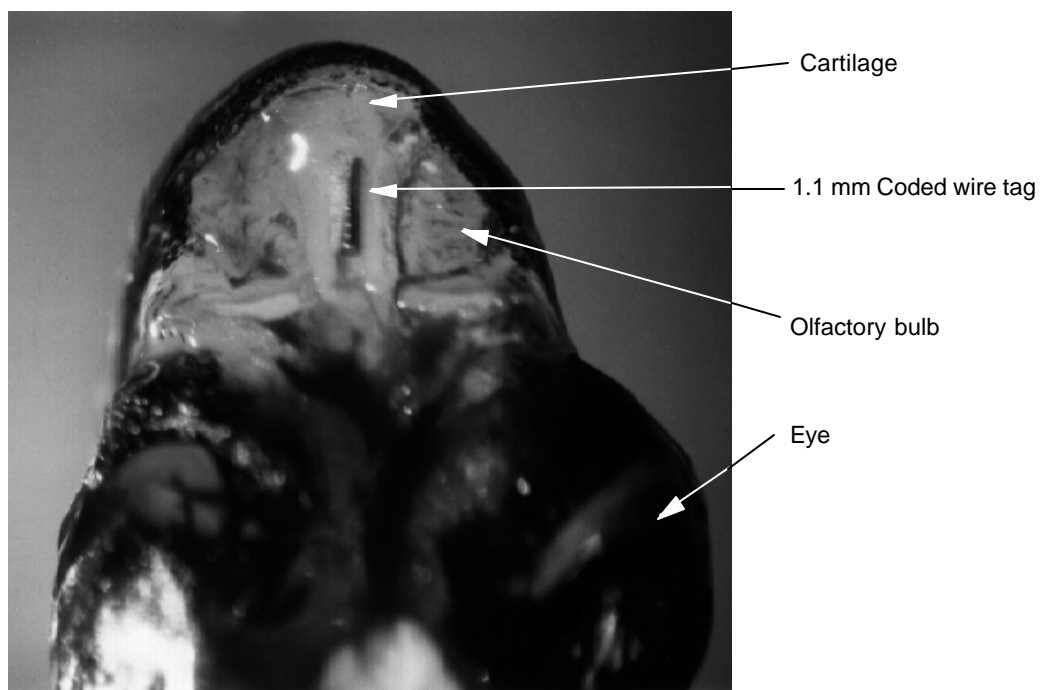
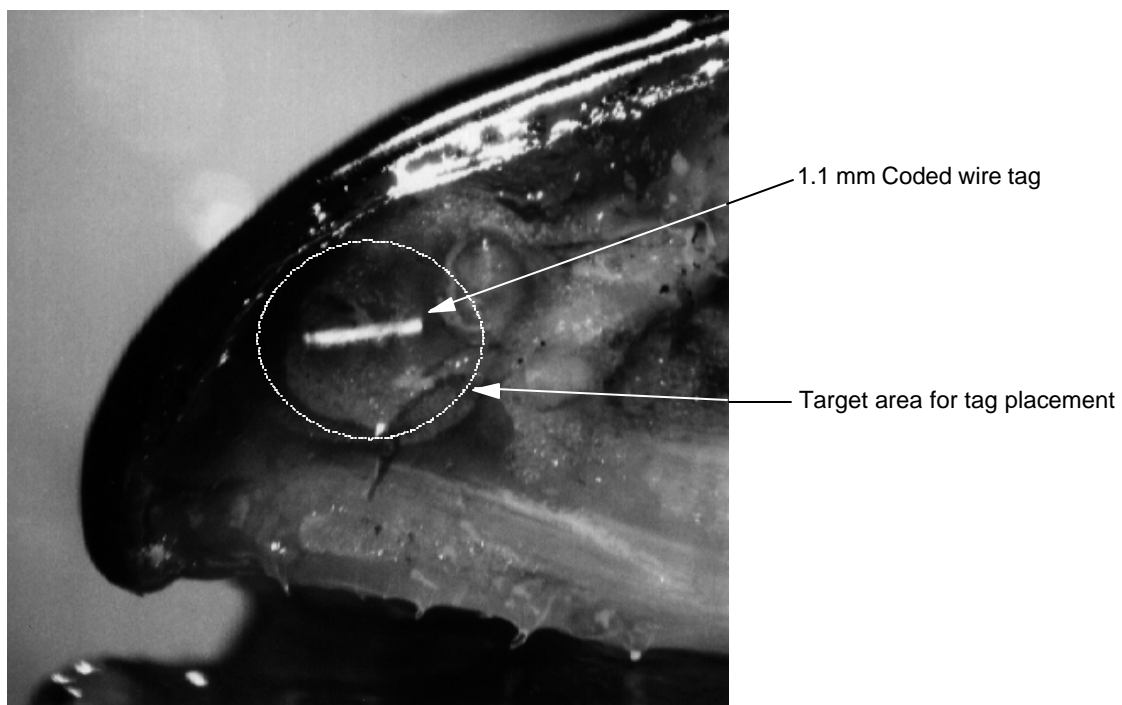


Figure 1.-Proper placement of a coded wire tag in a small fish.

After tagging, all fish were held in net pens overnight to determine short-term mortality and estimate short-term tag retention rate. All overnight mortalities were counted and recorded. Short-term retention rates were estimated daily by passing a random sample of 200 fish through the QCD. If the physical retention rate was at least 85%, this level of sampling would have provided an estimate that was within 5 percentage points of the true retention rate 95% of the time (Cochran 1977). Daily tag retention rate (\hat{D}_i) of smolt that were adipose-clipped, tagged, survived, and retained the tag was estimated as a binomial proportion:

$$\hat{D}_i = \frac{n_i}{n_{ti}}, \quad (1)$$

where:

n_i = number of live smolt in the sample tagged on day i that retained the tag, and

n_{ti} = total number of live smolt in the sample tagged on day i,

and a variance of:

$$\text{Var}(\hat{D}_i) = \frac{\hat{D}_i(1 - \hat{D}_i)}{n_{ti} - 1}. \quad (2)$$

Tagged smolt were combined with untagged smolt following overnight mortality checks, and all fish were treated the same until release. Fish mortality in each raceway was monitored daily and all marked and unmarked mortalities were recorded.

Long-term tag retention was estimated for all release groups at least 30 days after tagging (Blankenship 1990). Fish were crowded in each raceway, then at least 750 adipose clipped fish were randomly sampled from the population and checked for tag retention using a hand held CWT detector. If the physical retention rate was at least 90%, this level of sampling would have provided an estimate that is within 2.5 percentage points of the true retention rate 97.5% of the time (Cochran 1977). Long-term tag retention rate (\hat{D}_j) of smolt that were adipose-clipped, tagged, survived, and retained the tag, and its variance, were also estimated as a binomial proportion (equations 1 and 2) for each group,

where:

n_i = number of tagged smolt in the sample that retained the tag, and

n_{ti} = total number of tagged smolt in the sample.

The number of fish released with valid CWTs was estimated as:

$$\hat{T}_j = (N_j - M_j)\hat{D}_j, \quad (3)$$

and its variance as:

$$\text{Var}(\hat{T}_j) = (N_j - M_j)^2 \text{Var}(\hat{D}_j), \quad (4)$$

where:

N_j = number of fish injected with a tag in group j,

\hat{D}_j = long-term tag retention of release group j, and

M_j = total number of mortalities of tagged fish in group j.

Thermal Marking for the 2002 and 2003 Release Groups

Thermal marks were applied to all coho and Chinook salmon smolt released in 2002 and 2003. Thermal marks for release groups of coho and Chinook salmon were assigned by the Mark, Tag, and Age Laboratory operated by ADF&G's Division of Commercial Fisheries. Otoliths were developed enough to accept a mark at approximately 310 CTUs (centigrade temperature unit) for coho salmon and 360 CTUs for Chinook salmon, as verified by the Mark, Tag, and Age Laboratory. Embryos were exposed to a scheduled series of 4-5°C water temperature adjustments, with each temperature decrease resulting in the deposit of a dark ring of protein on the developing otolith (Monk *Unpublished*). Water temperature changes were scheduled to occur every 24 hours, with a 72-hour warm water exposure occurring between bands of rings for Chinook salmon. Specific patterns of dark protein rings were applied to the otolith to identify area of release or even specific release site (Figure 2). Onset Stowaway XTI data loggers recorded incubation water temperature every 15 minutes throughout the marking period to generate thermal profiles for each mark type (Figure 3).

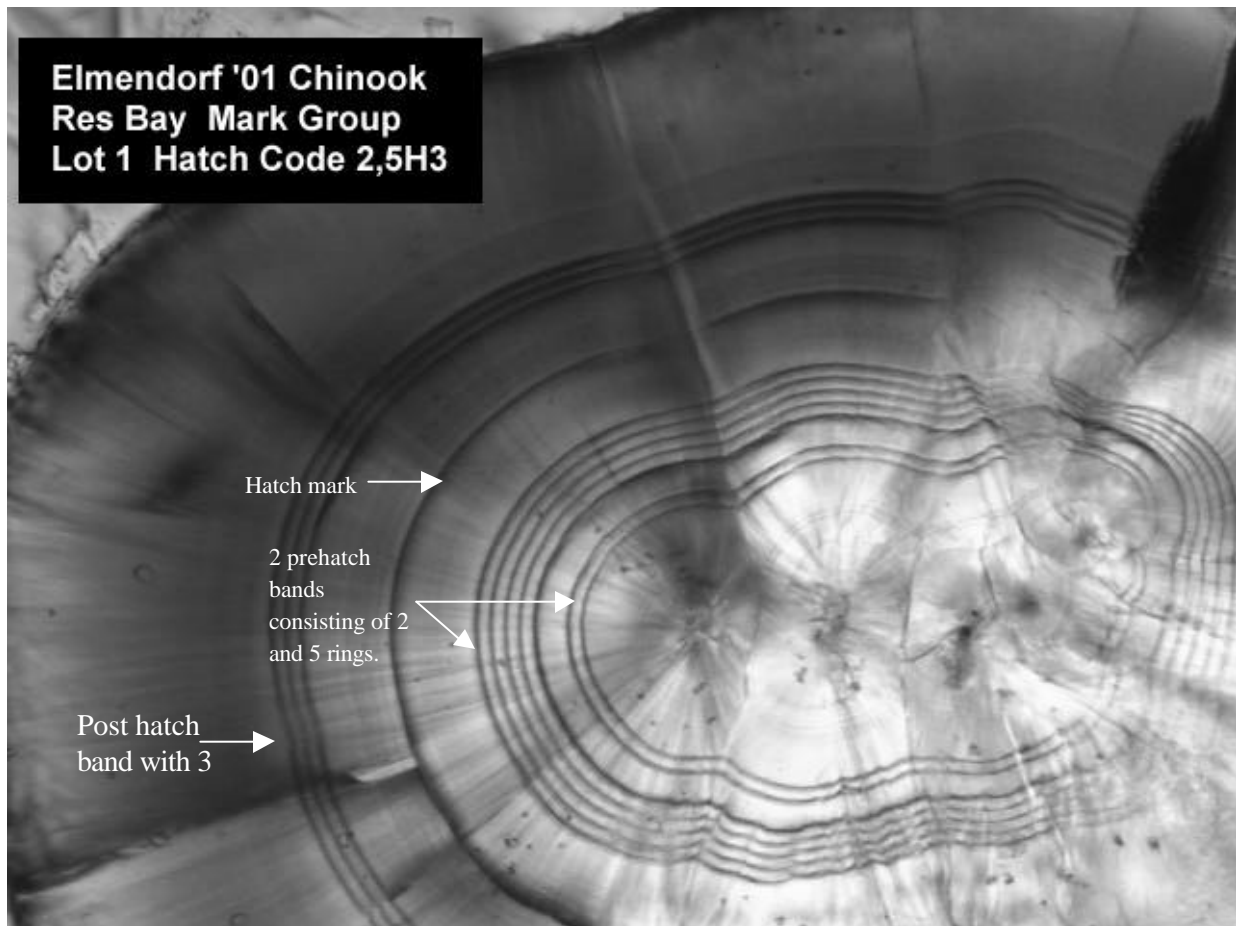


Figure 2.-Image of the thermal mark applied to Chinook salmon released into Resurrection Bay in 2002.

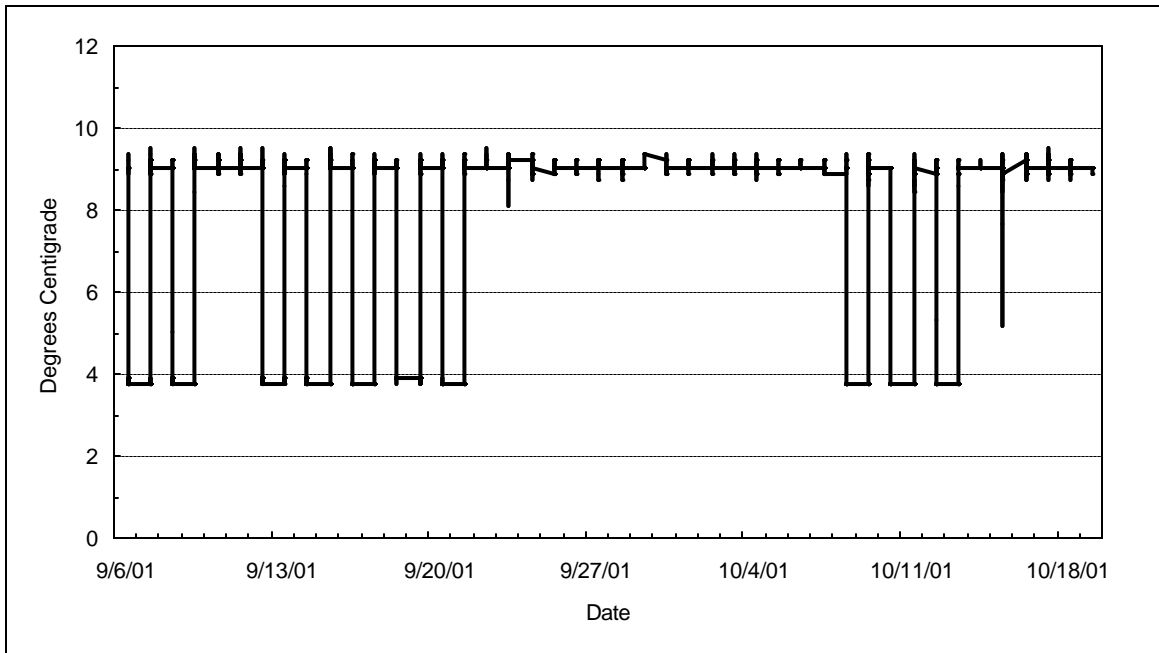


Figure 3.-Thermal marking temperature profile for Chinook salmon released into Resurrection Bay in 2002 with a thermal mark hatch code of 2,5H3.

Voucher samples containing approximately 50 fish from each lot of eggs were collected before ponding and submitted to the Mark, Tag, and Age Laboratory for mark verification.

Coho Salmon

Coho salmon to be released in 2002 were thermally marked in 2000; those to be released in 2003 were marked in 2001. Two different TMs were applied to identify the fish as either belonging to a Cook Inlet release group (1 band of 5 rings) or a Resurrection Bay release group (1 band of 4 rings). Thermal marking of coho salmon was completed before hatching occurred.

Chinook Salmon

Chinook salmon to be released in 2002 were thermally marked in 2001; those to be released in 2003 were marked in 2002.

At EH for the 2002 release groups, five different TMs were applied to identify the fish as being released into Ship Creek, Eklutna Tailrace, Crooked Creek, Resurrection Bay, or Kachemak Bay. Each TM at EH consists of two pre-hatch bands of rings, and one post-hatch band of rings. The first pre-hatch band consists of two rings. The second pre-hatch band and the post-hatch band each consist of three to five rings. At FRH, three different TMs were applied to identify the fish as being released into Deception Creek, Ninilchik River, or Prince William Sound. Each TM has two pre-hatch bands. The first band consists of two rings, and the second band consists of three to five rings.

For 2003 release groups, three different TMs were applied to identify the fish as belonging to a Cook Inlet, Resurrection Bay, or Prince William Sound release group. Each TM has two pre-hatch bands. The first band consists of two rings, and the second band consists of three to five rings. A temporary

loss of warm water occurred while marking the first band for 14 lots of eggs that received the Cook Inlet mark. Ninilchik River broodstock egg lots 5 and 6, and Ship Creek broodstock egg lots 4–6 were exposed to 30 hours of cold water followed by 42 hours of warm water instead of the planned 72 hours of warm water between marking the two bands of rings. Crooked Creek broodstock egg lots 1–4, and Deception Creek broodstock egg lots 1–5 experienced a 54-hour cold water cycle instead of a 24-hour cycle following the first temperature decrease. Because of the 30 hour delay, within band temperature changes for these egg lots were rescheduled to occur every 18 hours instead of 24 hours to ensure marking was completed before hatching began.

SMOLT ENUMERATION

The number of fish in each release group was estimated prior to release using a physical count, a hatchery inventory estimate, or a water volume estimate.

Physical Counts

A physical count was obtained for release groups for which all fish were tagged with CWTs because the Mark IV CWT injector counts injected tags. Thus the number of injected tags was the number of fish in a release group if all fish were tagged. For these groups, mortalities were monitored on a daily basis and subtracted from the original count to yield a final physical count for each release group

Hatchery Inventory Estimates

Elmendorf Hatchery

Hatchery inventory estimates at EH were based on the estimated weight of fish in the raceway, and the estimated mean weight of an individual fish in that raceway. In January and February each raceway was split into two or more raceways. The raceway was crowded and a dip net was used to remove fish. Each net of fish was held out of the water for several seconds to allow water to drain from the net. The fish were poured into a pre-weighed bucket of water and weighed to the nearest 5 grams. Fish to be tagged were placed into net pens, and the fish that were not to be tagged were placed into the new raceway. The weight was recorded and the total weight of all fish removed from the raceway was obtained by adding the individual net weights. The fish that remained in the original raceway were weighed into net pens or weighed back into the same raceway in the same manner that the fish that were transferred were weighed.

During the course of this operation three randomly selected net loads of fish from the beginning, middle, and end of the weighing process were sampled to obtain an estimate of individual fish weight. One net full of fish was too large to enumerate (approximately 1,300 fish). Consequently, the net was manually halved numerous times until approximately 150 fish were still in the net. These fish were weighed in the same manner as the other net loads and hand counted out of the bucket.

Mean weight was then divided into the total weight of fish moved out of each raceway to establish the hatchery inventory number in the new raceway as well as in the original raceway. Following the fish transfers, daily mortalities in each raceway were enumerated and subtracted from the individual raceway inventory estimates.

Fort Richardson Hatchery

At FRH, hatchery inventory estimates were also based on the estimated weight of fish in the raceway and the estimated mean weight of a fish in that raceway, but at FRH, these estimates were established

when the fry were moved from the small indoor raceways to the large outdoor raceways. During the course of this operation approximately 10 randomly selected net loads of fish were sampled to obtain an estimate of individual fish weight. As a net full of fish was too large to enumerate (approximately 600-800 fish), the net was manually halved numerous times until 50 to 100 fish were still in the net. These fish were weighed in the same manner as the other net loads and hand counted from the bucket. Mean weight was then divided into the total weight of fish moved into the outdoor raceway to establish the hatchery inventory estimate in that raceway. The number of fish released from an outdoor raceway was the original estimate minus any fish stocked or transferred, and minus the number of mortalities from date of loading into the outdoor raceway to the date of release.

Volumetric Estimates

The abundance of fish in a release group was estimated by determining the amount of fish (number or weight) in each tank when transporting fish to the release site. This estimate is a function of the tank volume (gallons), the estimated ratio of the volume of water displaced in the tank sight gauge to the volume of water placed in the tank (mm/gallon), and the estimated ratio of the number (or weight) of fish which displace a volume of water in the tank sight gauge (fish/mm or kg/mm).

At the time of transport, each tank on the transport vehicle was filled with water to the normal level for fish transport and the water level on the tank sight gauge recorded to the nearest millimeter. Fish were then pumped from the raceway into each transport tank. The water level on the tank sight gauge was recorded again after fish were banded into each tank. The millimeters of water displacement for each tank sight gauge was determined, and using a known displacement value of kilograms of fish per millimeter of water displaced in the tank sight gauge, the total weight of fish in the tank was estimated. Total number of fish was then estimated by dividing the total weight by the estimated mean weight of a fish.

SIZE ESTIMATION

Within 7 days of release, a minimum of 510 fish was individually measured for length and weight from each rearing unit for each release group containing CWTs. Fish were crowded to one end of the raceway and a sample was netted and put into a small holding pen. Each fish was measured to the nearest millimeter using an electronic fish measuring board, and weighed to the nearest 0.1 gram on an electronic scale.

RESULTS

CODED WIRE TAGGING

In 2001, we released 174,438 coho salmon and 499,313 Chinook salmon smolt with adipose clips at seven locations in Cook Inlet and 3 in Prince William Sound (Tables 4 and 5). Tagging goals were achieved for all release groups. All of the smolt in the Ninilchik River and Deception Creek Chinook salmon smolt release groups at FRH were marked and tagged, as were the Crooked Creek Chinook releases at EH. Long-term tag retention was checked 63-224 days after tagging (Tables 4 and 5). Tag retention for the release groups ranged from 96.1% to 99.6% with an overall mean of 97.9% for coho salmon and 98.8% for Chinook salmon. The percentage of the total release that was marked per release group ranged from 27.5% to 100% (Tables 4 and 5). In 2002, we released 180,764 coho

Table 4.-Summary of coded wire tagging data and release estimates at Fort Richardson Hatchery for coho salmon smolt stocked at four locations in Cook Inlet, 2001.

Parameter	Release Location				Totals
	Campbell Creek	Homer Spit	Eklutna Tailrace	Ship Creek	
Tag Codes	31-02-32	31-01-36	31-02-47	31-02-61	
Total adipose-clipped and tagged	21,577	45,040	43,727	64,207	174,551
Mortalities	9	48	14	42	113
Adipose-clipped fish released	21,568	44,992	43,713	64,165	174,438
Tag retention sample size	753	796	773	1,615	
Tag retention at release	96.5%	99.6%	99.5%	96.1%	97.9%
Tag retention variance	4.43E-05	4.72E-06	6.67E-06	2.32E-05	
Tagged fish released ^a	20,813	44,812	43,494	61,663	170,782
Tagged fish variance	20,621	9,560	12,742	95,605	
Total fish released	69,836	100,280	124,838	233,563	528,517
Percent marked	30.9%	44.9%	35.0%	27.5%	33.0%
Tagging dates	10/24/2000	10/26/2000	10/16/2000	11/2/2000	
	10/26/2000	11/2/2000	10/24/2000	11/13/2000	
Date of tag retention check	5/23/2001	5/31/2001	6/5/2001	5/22/2001	
Days elapsed	209	210	224	190	

^a Total fish released is a hatchery inventory estimate.

salmon and 481,196 Chinook salmon smolt with adipose clips at seven locations in Cook Inlet and three in Prince William Sound (Tables 6 and 7). Tagging goals were achieved for all release groups. All smolt in the Ninilchik River and Deception Creek Chinook salmon smolt release groups at FRH, and in the Crooked Creek Chinook salmon release group at EH were adipose-clipped and tagged. Long-term tag retention was checked 57-223 days after tagging (Tables 6 and 7). Tag retention for the release groups ranged from 93.7% to 99.6% with an overall mean of 96.2% for coho salmon and 99.0% for Chinook salmon. The percentage of the total release that was adipose-clipped per release group ranged from 32.0% to 100% (Tables 6 and 7).

In 2003, we released 64,234 coho salmon and 247,978 Chinook salmon smolt with adipose clips at four locations in Cook Inlet (Table 8). All smolt in the Ninilchik River, Crooked Creek, and Deception Creek Chinook salmon smolt release groups were adipose-clipped and tagged. Tagging goals were achieved for all release groups. Long-term tag retention was checked 70-104 days after tagging (Table 8). Tag retention for the release groups ranged from 92.4% to 99.8%. The percentage of the total release that was marked per release group ranged from 27.4% to 100% (Table 8).

Table 5.-Summary of coded wire tagging data and release estimates at Fort Richardson and Elmendorf hatcheries for Chinook salmon smolt stocked in Cook Inlet and Prince William Sound, 2001.

Parameter	Ft. Richardson Hatchery		Elmendorf Hatchery				Totals
	Deception Creek ^a & Head ^a	Ninilchik River Tail ^a	Fleming Spit ^b	Valdez Harbor ^b	Whittier Harbor ^b	Crooked Creek ^a	
Tag Codes	31-02-41, 42,43,44,45	31-02-60	31-02-38	31-02-39	31-02-40	31-02-36 31-02-37 31-01-95	
Total adipose-clipped and tagged	207,667	54,802	40,792	44,516	42,916	109,740	500,433
Mortalities	202	32	133	98	116	539	1,120
Adipose-clipped fish released	207,465	54,770	40,659	44,418	42,800	109,201	499,313
Tag retention sample size	1,551	770	842	776	795	789	
Tag retention at release	98.6%	99.4%	99.4%	99.0%	99.2%	98.4%	98.8%
Tag retention variance	9.20E-06	8.39E-06	7.02E-06	1.32E-05	9.43E-06	2.06E-05	
Tagged fish released	204,560	54,441	40,415	43,974	42,458	107,454	493,302
Tagged fish variance	395,778	25,166	11,603	25,974	17,281	245,233	
Total fish released	207,465	54,770	94,812	94,701	95,823	109,201	656,772
% marked	100.0%	100.0%	42.9%	46.9%	44.7%	100.0%	76.0%
Tagging dates	3/2/01 4/2/01	4/3/01 4/9/01	2/9/01 2/15/01	2/15/01 2/22/01	2/23/01 2/28/01	1/23/01 2/8/01	
Date of tag retention check	6/15/01	6/11/01	5/29/01	5/21/01	5/29/01	5/31/01	
Days elapsed	74	63	103	88	90	112	

^a Total fish released was determined by a physical count.

^b Total fish released was a hatchery inventory estimate.

Table 6.-Summary of coded wire tagging data and release estimates at Fort Richardson Hatchery for coho salmon smolt stocked in Cook Inlet, by release site, 2002.

Release Site Parameter	Release Location				Totals
	Campbell Creek	Homer Spit	Eklutna Tailrace	Ship Creek	
Tag Codes	31-01-97	31-01-98	31-02-46	31-02-83	
Total adipose-clipped and tagged	22,796	45,802	44,551	68,130	181,279
Mortalities	7	304	33	171	515
Adipose-clipped fish released	22,789	45,498	44,518	67,959	180,764
Tag retention sample size	797	758	772	1,560	
Tag retention at release	95.1%	97.1%	99.5%	93.7%	96.2%
Tag retention variance	5.85E-05	3.72E-05	6.69E-06	3.81E-05	
Tagged fish released	21,672	44,179	44,295	63,678	173,824
Tagged fish variance	30,364	77,064	13,250	176,069	
Total fish released ^a	61,323	95,648	120,629	212,639	490,239
Percent adipose-clipped	37.2%	47.6%	36.9%	32.0%	36.9%
Naturally missing adipose fins	0.09%	0.10%	0.02%	0.16%	
Tagging dates	11/5/01	10/29/01	10/22/01	11/7/01	
	11/6/01	11/2/01	10/26/01	11/15/01	
Date of tag retention check	5/29/02	5/16/02	6/6/02	5/22/02	
Days elapsed	204	197	223	188	

^a Total fish released is a hatchery inventory estimate.

THERMAL MARKING

In 2002, voucher samples verified that all release groups of coho salmon and 12 of the 13 release groups of Chinook salmon were marked with their proposed TM. The proposed TM hatch code for Crooked Creek Chinook salmon was 2,4H5. The actual TM hatch code for that release group was 2,4H4. The TM hatch code for Chinook salmon released into Ship Creek was also 2,4H4 (Table 9).

In 2003, thermal marks appeared as a single band consisting of 4 rings for Resurrection Bay coho salmon release groups, and as a single band of 5 rings for Cook Inlet coho salmon release groups (Table 10).

The loss of hot water during the Chinook salmon thermal marking process caused a 30-hour delay in the scheduled temperature increase between the 2 bands of rings for Ninilchik River broodstock egg lots 5 and 6, and Ship Creek broodstock egg lots 4–6 that received the Cook Inlet mark (Table 9). The TMs for these egg lots have a hatch code of 2,3H, but the spacing between the bands of rings is narrower than it is for egg lots that received 72 hours of heated water between bands. The hot water loss occurred between applying the 2 rings of the first band for Cook Inlet mark type Crooked Creek broodstock egg lots 1–4, and Deception Creek broodstock egg lots 1–5. The distance between the two rings of the first band is wider for these lots than for all other egg lots. The distance between rings

Table 7.—Summary of coded wire tagging data and release estimates at Elmendorf and Fort Richardson hatcheries for Chinook salmon smolt stocked in Cook Inlet and Prince William Sound, by release site, 2002.

Parameter	Fort Richardson					Elmendorf	Totals
	Deception Creek ^a & Head ^a	Ninilchik River Tail ^a	Fleming Spit ^b	Valdez Harbor ^b	Whittier Harbor ^b	Crooked Creek ^a	
Tag Codes	31-01-92, 31-02-52, 53,54,55	31-02-82	31-02-57	31-02-58	31-02-59	31-02-51 31-01-96 31-01-99	
Total adipose-clipped and tagged	197,497	55,248	40,159	43,887	46,028	99,842	482,661
Mortalities	220	617	105	54	174	295	1,465
Adipose-clipped fish released	197,277	54,631	40,054	43,833	45,854	99,547	481,196
Tag retention sample size	1,565	783	771	764	816	761	
Tag retention at release	99.6%	99.1%	98.8%	97.3%	97.7%	98.9%	99.0%
Tag retention variance	2.85E-06	1.13E-05	1.50E-05	3.50E-05	2.79E-05	1.37E-05	
Tagged fish released	196,608	54,139	39,573	42,650	44,799	98,452	476,222
Tagged fish variance	110,803	33,815	24,038	67,313	58,672	135,631	
Total fish released	197,277	54,631	109,656	107,861	109,763	99,547	678,735
% adipose-clipped	100.0%	100.0%	36.5%	40.6%	41.8%	100.0%	70.9%
Naturally missing adipose fins	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Tagging dates	2/25/02 3/22/02	2/14/02 2/22/02	3/26/02 4/1/02	4/2/02 4/8/02	4/9/02 4/14/02	1/30/02 2/12/02	
Date of tag retention check	6/20/02	6/13/02	6/7/02	6/11/02	6/10/02	6/4/02	
Days elapsed	90	111	67	64	57	112	

^a Total fish released was determined by a physical count.

^b Total fish released was a hatchery inventory estimate.

Table 8.-Summary of coded wire tagging data and release estimates at Fort Richardson Hatchery for coho and Chinook salmon smolt stocked in Cook Inlet, by release site, 2003.

Parameter	Coho Salmon	Chinook Salmon			
	Ship Creek a	Deception Creek b	Ninilchik River Tail ^b	Crooked Creek b	Total Chinook Salmon
Tag Codes	31-02-74 31-02-69	31-02-70 31-02-71 31-01-94	31-02-56 31-01-93	31-02-72 31-02-73 31-02-68	
Total adipose-clipped and tagged	64,468	101,407	48,093	99,237	248,737
Mortalities	234	226	96	437	759
Adipose-clipped fish released	64,234	101,181	47,997	98,800	247,978
Tag retention sample size	1,537	765	760	793	
Tag retention at release	99.8%	98.4%	92.4%	95.2%	96.0%
Tag retention variance	1.41E-06	2.02E-05	9.29E-05	5.76E-05	
Tagged fish released	64,125	99,562	44,349	94,058	237,969
Tagged fish variance	5,819	206,899	213,956	562,306	
Total fish released	234,716	101,181	47,997	98,800	247,978
Percent adipose-clipped	27.4%	100.0%	100.0%	100.0%	
Tagging dates	2/3/03 2/13/03	2/14/03 3/5/03	3/24/03 4/1/03	3/6/03 3/21/03	
Date of tag retention check	5/27/03 5/28/03	6/17/03	6/10/03	6/3/03	
Days elapsed	103	104	70	74	

^a Total fish released is a hatchery inventory estimate.

^b Total fish released was determined from a physical count.

of the second band for these egg lots is closer than it is for other lots since the temperature changes occurred every 18 hours instead of the scheduled 24.

SMOLT RELEASES

In 2001, 19 release groups of coho and Chinook salmon smolt were stocked in Cook Inlet and Prince William Sound. Based on hatchery inventory estimates, 903,600 coho salmon smolt were released from FRH. Using both physical counts and hatchery inventory methods, 1,557,165 Chinook salmon smolt were estimated to have been released from FRH and EH (Table 1).

In 2002, 20 release groups of Chinook and coho salmon smolt were stocked in Cook Inlet, Prince William Sound, and Resurrection Bay. At FRH, estimated release based on hatchery inventory methods was 852,201 coho salmon smolt. Estimated release from FRH and EH totaled about 1,649,187 Chinook salmon smolt based on physical counts and hatchery inventory and volumetric methods (Table 2).

Table 9.-Summary of thermal mark codes applied at Elmendorf and Fort Richardson hatcheries for Chinook and coho salmon smolt stocked in Cook Inlet, Prince William Sound, and Resurrection Bay, 2002.

Mark Group	Hatch Code	Release Site
Elmendorf Hatchery		
<u>Chinook Salmon</u>		
Crooked Creek	2,4H4 ^a	Crooked Creek
Eklutna Tailrace	2,3H3	Eklutna Tailrace
Kachemak Bay	2,4H3	Halibut Cove
Kachemak Bay	2,4H3	Homer Spit
Kachemak Bay	2,4H3	Seldovia
Resurrection Bay	2,5H3	Lowell Creek
Resurrection Bay	2,5H3	Seward Lagoon
Ship Creek	2,4H4	Ship Creek
Fort Richardson Hatchery		
<u>Coho Salmon</u>		
Cook Inlet	5H	Campbell Creek
Cook Inlet	5H	Eklutna Tailrace
Cook Inlet	5H	Homer Spit ^b
Cook Inlet	5H	Homer Spit ^c
Cook Inlet	5H	Ship Creek
Resurrection Bay	4H	Lowell Creek
Resurrection Bay	4H	Seward Lagoon
<u>Chinook Salmon</u>		
Deception Creek	2,5H	Deception Creek
Ninilchik River	2,3H	Ninilchik River
Prince William Sound	2,4H	Fleming Spit
Prince William Sound	2,4H	Valdez Harbor
Prince William Sound	2,4H	Whittier Harbor

^a Final temperature drop on post hatch band did not occur. Proposed hatch code was 2,4H5.

^b Ship Creek broodstock

^c Bear Lake broodstock

Table 10.-Summary of thermal mark codes applied at Elmendorf and Fort Richardson hatcheries for Chinook and coho salmon smolt stocked in Cook Inlet, Prince William Sound, and Resurrection Bay, 2003.

Mark Group	Hatch Code	Release Site
<u>Chinook Salmon</u>		
Cook Inlet	2,3H	Crooked Creek
Cook Inlet	2,3H	Deception Creek
Cook Inlet	2,3H	Eklutna Tailrace
Cook Inlet	2,3H	Halibut Cove
Cook Inlet	2,3H	Homer Spit
Cook Inlet	2,3H	Ninilchik River
Cook Inlet	2,3H	Seldovia
Cook Inlet	2,3H	Ship Creek
Resurrection Bay	2,5H	Lowell Creek
Resurrection Bay	2,5H	Seward Lagoon
Prince William Sound	2,4H	Fleming Spit
Prince William Sound	2,4H	Valdez Harbor
Prince William Sound	2,4H	Whittier Harbor
<u>Coho Salmon</u>		
Cook Inlet	5H	Campbell Creek
Cook Inlet	5H	Eklutna Tailrace
Cook Inlet	5H	Homer Spit
Cook Inlet	5H	Ship Creek
Resurrection Bay	4H	Lowell Creek
Resurrection Bay	4H	Seward Lagoon

In 2003, 19 release groups of coho and Chinook salmon smolt were stocked in Cook Inlet, Prince William Sound, and Resurrection Bay. Estimated release was 1,765,968 Chinook salmon smolt based on physical counts and hatchery inventory methods. Using hatchery inventory methods, an estimated 904,870 coho salmon smolt were released (Table 3).

SIZE ESTIMATION

In 2001, at FRH only the Campbell Creek coho salmon release group achieved the production goal of 80% of the fish weighing between 15.1 and 25.0 g (Table 11, Figure 4). More than 70% of the fish in the other three coho salmon release groups weighed between 15.1 and 25.0 g. At EH, the Valdez Harbor and Whittier Harbor Chinook salmon release groups achieved the production goal of 80% of the fish weighing between 5.1 and 15.0 g. Neither of the other two release groups of Chinook salmon at EH nor the two release groups of Chinook salmon at FRH achieved the production goal.

Table 11.-Percentage of coho and Chinook salmon smolt raised at Ft. Richardson and Elmendorf hatcheries that were within, smaller than, and larger than the target range, 2001-2003.

Release Group	Percent		
	Below	Within	Above
Coho Salmon - Ft. Richardson^a			
2001			
Campbell Creek	7.9%	80.0%	12.1%
Homer Spit	6.0%	73.8%	20.2%
Eklutna Tailrace	1.1%	70.3%	28.6%
Ship Creek	6.4%	74.2%	19.4%
2002			
Campbell Creek	9.9%	73.5%	16.6%
Homer Spit	8.3%	78.0%	13.7%
Eklutna Tailrace	16.3%	78.7%	5.0%
Ship Creek	14.4%	76.8%	8.8%
2003			
Ship Creek	12.0%	77.5%	10.5%
Chinook Salmon - Ft. Richardson^b			
2001			
Deception Creek	0.1%	64.2%	35.7%
Ninilchik River	0.2%	73.4%	26.4%
2002			
Deception Creek	0.1%	88.5%	11.4%
Ninilchik River	0.0%	84.1%	15.9%
Fleming Spit	0.0%	85.8%	14.2%
Valdez Harbor	0.2%	89.2%	10.6%
Whittier Harbor	0.0%	84.2%	15.8%
2003			
Deception Creek	0.0%	59.3%	40.7%
Ninilchik River	0.0%	81.6%	18.4%
Crooked Creek	0.4%	76.3%	23.3%
Chinook Salmon - Elmendorf Hatchery^c			
2001			
Fleming Spit	0.0%	73.7%	26.3%
Valdez Harbor	0.0%	96.5%	3.5%
Whittier Harbor	0.0%	83.4%	16.6%
Crooked Creek	0.2%	74.9%	24.9%
2002			
Crooked Creek	0.0%	72.5%	27.5%

^a Production goal for coho salmon: 80% of smolts 15.1-25.0 grams.

^b Production goal for Chinook salmon: 80% of smolts 5.1-15 grams.

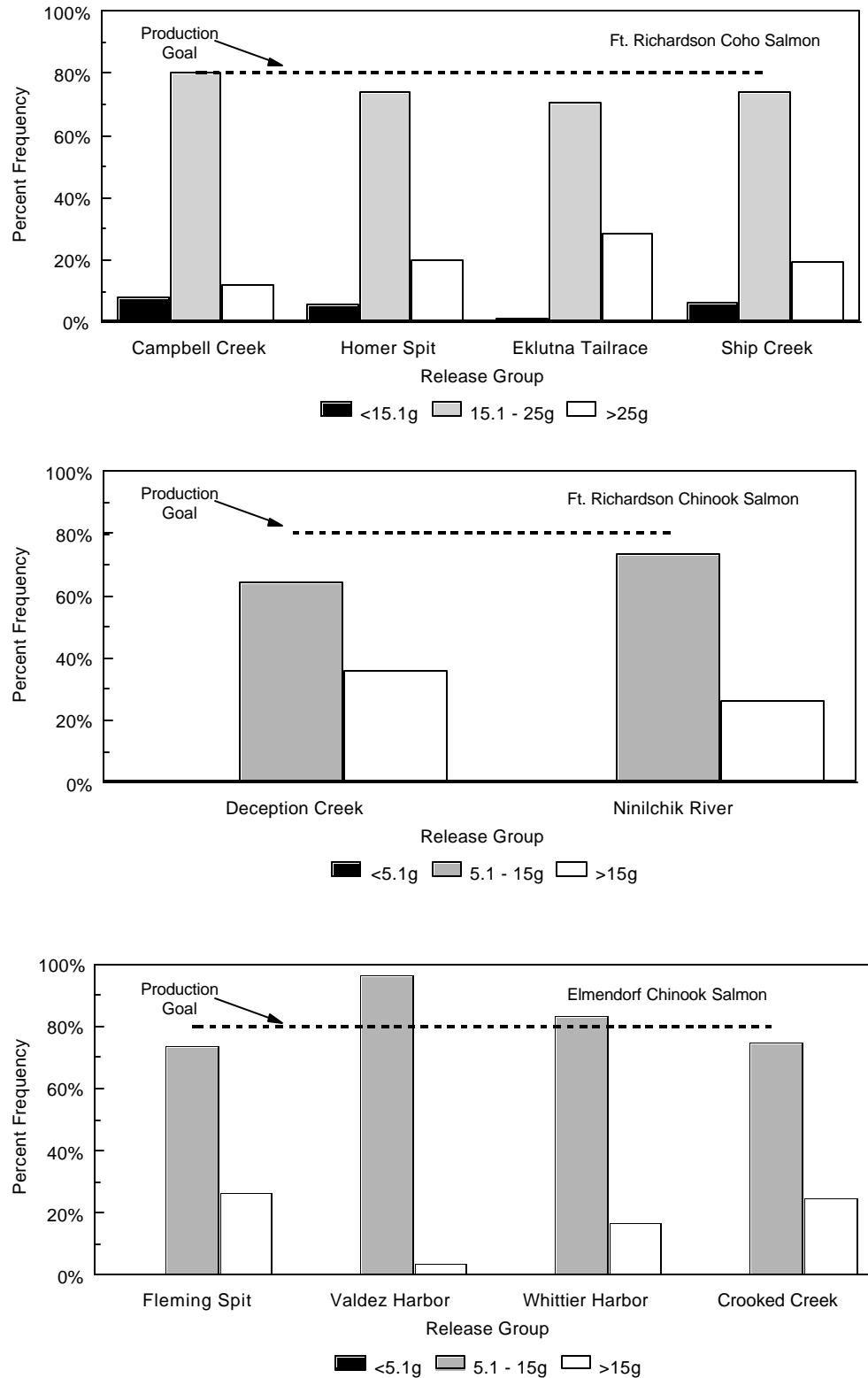


Figure 4.-Weight distribution, by release group, of coho and Chinook salmon smolt raised at Ft. Richardson and Elmendorf hatcheries, 2001. Production goal was at least 80% of smolt within ideal weight range (gray bars).

In 2002 at FRH, none of the coho salmon release groups sampled achieved the production goal, but more than 70% of the fish in each release group were within the target size range (Table 11, Figure 5). All five Chinook salmon release groups sampled at FRH achieved the production goal, and 72.5% of the Crooked Creek Chinook salmon release group sampled at EH achieved the target size range (Table 11, Figure 5).

In 2003, the Ship Creek release group nearly achieved the production goal at FRH (77.5%, Table 11, Figure 6). The Ninilchik River Chinook salmon release group achieved the production goal and the Crooked Creek release group nearly achieved the goal. Approximately 40% of the smolt in the Deception Creek release group was larger than the target size range (Table 11, Figure 6).

DISCUSSION

SMOLT MARKING

A major point of emphasis for the marking program has been to achieve good long-term tag retention rates. Overall retention levels remained steady at greater than 97% from 1994-2002, but dropped to 96.8% in 2003 season. Grading fish and using different sizes of head molds for tagging is responsible for maintaining acceptable long-term tag retention rates. Poor tag placement contributed to a lower than normal long-term tag retention rate for coho salmon tagged at FRH and released into Ship Creek and Campbell Creek in 2001 and 2002, and for Chinook salmon released into Ninilchik River and Crooked Creek in 2003.

In 2002, fish with naturally missing adipose fins were observed in each coho salmon release group. The Ship Creek (Little Susitna River) broodstock release groups had the highest incidence of naturally missing adipose fins (Campbell Creek: 0.092%, Homer Spit: 0.105%, Ship Creek: 0.161%), and had the lowest long-term retention rate (93.7%; Table 6). The Eklutna Tailrace (Jim Creek) broodstock release group had the lowest incidence of naturally missing adipose fins (Eklutna Tailrace: 0.020%), and had the highest long-term retention rate of 99.5%. The same tagging crew tagged all groups of coho salmon. The reported incidence of naturally missing adipose fins in the coho salmon release groups is not enough to account for the differences in long term retention rates amongst the release groups. The reported incidence of naturally missing adipose fins in all Chinook salmon release groups was 0.0%. Long-term CWT retention rates for all Chinook salmon release groups were higher than those of the Ship Creek (Little Susitna River) broodstock coho salmon release groups (Tables 6 and 7).

THERMAL MARKING

The 2002 and 2003 release groups of coho and Chinook salmon are the first releases of thermally marked salmon from EH and FRH. The TMs in all groups reflect the temperature changes depicted in the corresponding thermal profiles. In 2002, the thermal marking temperature profile for the Crooked Creek release group indicated these fish experienced 4 temperature decreases during post hatch marking rather than the 5 planned. The TM temperature profile for the Crooked Creek Chinook salmon release group resulted in a TM hatch code that is identical to the TM hatch code for the Ship Creek Chinook salmon release group. All fish released into Crooked Creek in 2002 can be identified by their TM and adipose-clip.

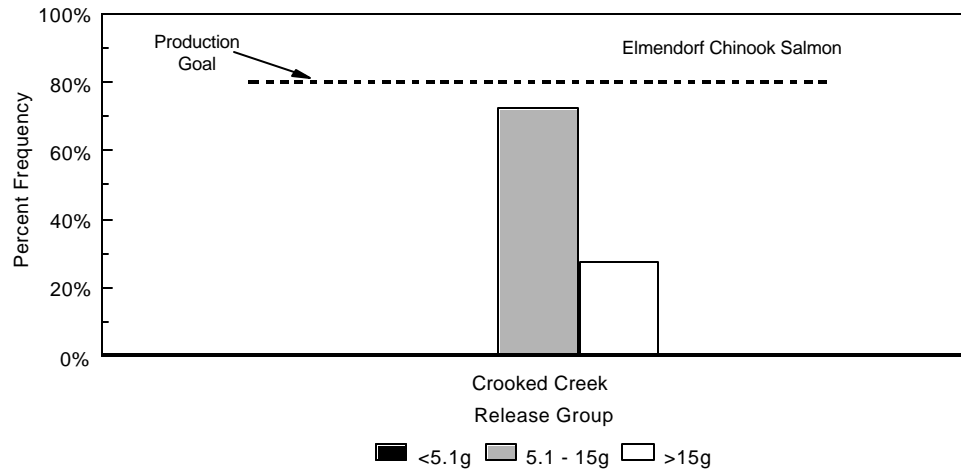
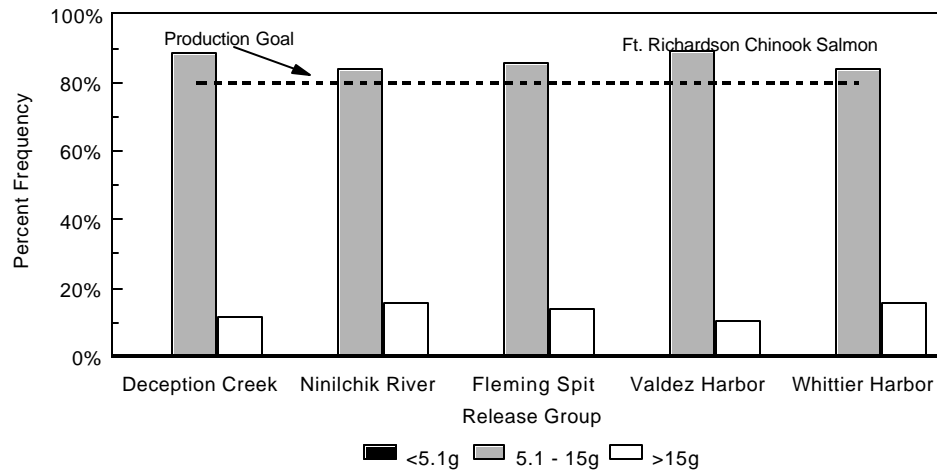
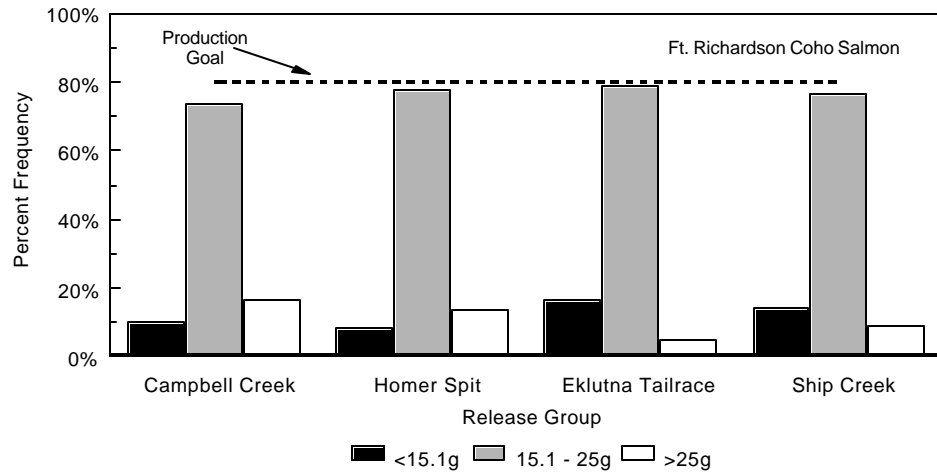


Figure 5.-Weight distribution, by release group, of coho and Chinook salmon smolt raised at Ft. Richardson and Elmendorf hatcheries, 2002. Production goal was at least 80% of smolt within ideal weight range (gray bars).

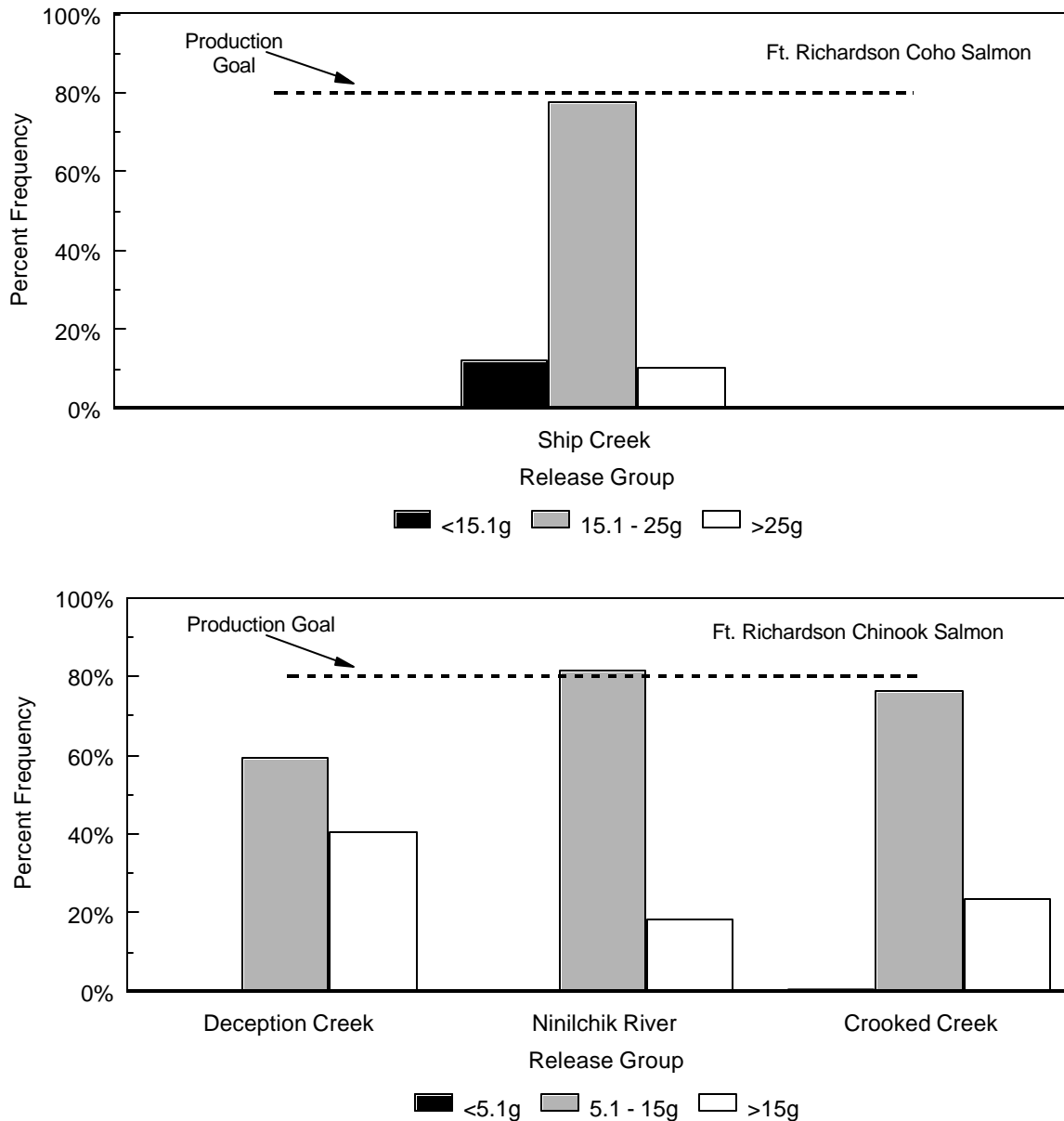


Figure 6.-Weight distribution, by release group, of coho and chinook salmon smolt raised at Ft. Richardson Hatchery, 2003. Production goal was at least 80% of smolt within ideal weight range (gray bars).

For the 2003 releases, the loss of heat during the marking of the first band of rings had a noticeable effect on the thermal marks for Crooked Creek broodstock egg lots 1-4, and Deception Creek broodstock egg lots 1-5 that were to receive the Cook Inlet mark. All of the Crooked Creek broodstock fish with the altered Cook Inlet mark type were released into Crooked Creek. All of the Deception Creek broodstock fish with the altered Cook Inlet mark type were released into Deception Creek. Images of the altered mark are on record with the ADF&G Mark, Tag and Age Laboratory.

SMOLT ENUMERATION

For release groups in which 100% of the fish were tagged with CWTs, the number of fish released was a physical count. Beginning in 1997 and 1998, improved hatchery inventory techniques have made this inventory method as reliable as the mark-recapture estimation technique at EH and FRH (Starkey et al. 1999).

In 2002, EH reported volumetric estimates for release groups that did not contain fish with CWTs. Peltz and Hansen (1994) reported that numerous sources of error associated with water displacement values make the water volume displacement method of estimating populations unreliable. They recommended that this estimation technique be used only when other estimation techniques can not be used or when accuracy is not important. Loopstra et al. (2002) reported that hatchery inventory estimates based on total weight of fish in the raceway are more reliable than mark-recapture estimates at EH. Because total weight of fish was not determined for each raceway in 2002, volumetric estimates were reported.

SIZE ESTIMATION

To maximize ocean survival and maintain the age composition of the population, Peltz and Starkey (1993) recommended a production goal of 80% of hatchery coho smolt weighing between 15.1 and 25.0 g, and hatchery Chinook salmon weighing between 5.1 and 15.0 g at release. Prior to 2001, an abundance of warm water at EH resulted in Chinook salmon release groups with up to 90% of the fish being larger than the production goal size range (Loopstra et al. 2000a, 2000b, Loopstra et al. 2002; Starkey et al. 1997; Starkey et al. 1999). In 2001 and 2002, cooler incubation water temperatures than those used in previous years delayed Chinook salmon hatch timing at EH, which contributed to a reduction in fish size. In 2001 and 2002, EH release groups achieved or came close to achieving the recommended production goal.

At FRH cool water is used for rearing, and the range of fish sizes came close to the recommended levels for most release groups in 2001 and 2002.

In 2003, poor road conditions delayed the stocking of the Deception Creek Chinook salmon by nearly 1 month, resulting in fish growth beyond the production goal. The increase in release size may result in an increase in the number of 1-ocean jacks returning to Deception Creek in 2004.

RECOMMENDATIONS

1. All fish for tagging should be graded and tagged using the appropriate head mold sizes that consistently provide proper tag placement for specific stocks or species of fish. The head mold that is closest to being the appropriate size for these fish should be adjusted for use with these fish.
2. Follow size at release recommendations of 80% of coho salmon weighing between 15.1 g and 25.0 g, and 80% of Chinook salmon weighing between 5.1 g and 15.0 g in order to maximize marine survival and minimize the contribution of precocious fish to the return. Cooler incubating and rearing temperatures help delay development and reduce the growth of these fish, thus increasing the percentage of fish that achieve the recommended release size.

3. The overall long-term CWT retention rate in coho salmon release groups improved over 1999 and 2000, but was about 96% in 2001 and 2003, and there was inconsistency amongst the retention rates for individual release groups. Greater care in tag placement should help increase or maintain acceptable long-term retention rates for all groups.

Greater care in recording naturally missing and deformed adipose fins during the adipose finclipping process may help explain low long-term retention rates.

4. Temperature changes of 4–5°C should occur every 24 hours between rings, and every 72 hours between bands of rings while thermal marking.

ACKNOWLEDGMENTS

We would like to thank Jeff Milton, Darrell Keifer and Andrea Tesch for their help and cooperation during thermal marking and coded wire tagging operations at Fort Richardson and Elmendorf hatcheries. We would also like to thank the members of the tagging crew for performing an excellent job at each hatchery.

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APPENDIX A

Appendix A1.-Historical releases of coho salmon that were adipose-clipped and tagged with coded wire tags, and/or thermally marked.

Brood		Hatchery	Release		Total Released		Coded Wire Tagged			Thermal Marking	
					Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Year	Broodstock		Year	CWT Code							
Anchorage Urban Streams^b											
1994	Little Susitna	Ft Richardson	1996	31-25-06	302,857	M-R	93,975	92,565	30.56%		
Bird Creek											
1990	Little Susitna	Ft Richardson	1992	31-20-02 31-20-03	95,377	M-R	44,903	37,629	39.50%		
1991	Little Susitna	Ft Richardson	1993	31-21-39	140,382	M-R	43,441	42,350	30.20%		
1992	Little Susitna	Ft Richardson	1994	31-23-02	84,643	M-R	45,220	44,686	52.80%		
1993	Little Susitna	Ft Richardson	1995	31-23-37	154,753	M-R	45,666	45,490	29.40%		
1994	Little Susitna	Ft Richardson	1996	31-25-04	147,618	M-R	46,528	45,411	30.80%		
1995	Little Susitna	Ft Richardson	1997	31-26-01	146,612	HI	45,901	45,488	31.03%		
1995	Little Susitna	Ft Richardson	1997	31-26-27	147,953	HI	45,836	45,469	30.73%		
1996	Little Susitna	Ft Richardson	1998	31-26-25	164,211	HI	46,140	46,094	28.07%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-26-15	111,430	EC	37,344	36,746	32.98%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-01-43	97,409	EC	40,114	39,392	40.44%		

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				Total Released		Coded Wire Tagged			Thermal Marking		
Brood			Release		Type of	Clipped	Tagged				
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released	Fish Released	Percent Tagged	Mark Group	Hatch Code
Campbell Creek^b											
1990	Little Susitna	Ft Richardson	1992	31-20-04 31-20-05	97,076	M-R	43,681	39,444	40.60%		
1991	Little Susitna	Ft Richardson	1993	31-21-38	140,797	M-R	43,440	42,916	30.50%		
1992	Little Susitna	Ft Richardson	1994	31-23-03	87,686	M-R	44,144	42,963	49.00%		
1993	Little Susitna	Ft Richardson	1995	31-23-36	157,241	M-R	45,655	44,995	28.60%		
1995	Little Susitna	Ft Richardson	1997	31-25-62	71,519	PC	45,840	45,290	63.33%		
1996	Little Susitna	Ft Richardson	1998	31-26-52	83,317	HI	22,453	22,296	26.76%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-01-30	42,046	EC	20,879	20,378	48.47%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-02-30	63,730	EC	19,948	19,549	30.67%		
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-02-32	69,836	HI	21,568	20,813	29.80%		
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-01-97	61,323	HI	22,789	21,672	35.34%	Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003		78,576	HI				Cook Inlet	5H
Cottonwood Creek											
1990	Fish Creek	Big Lake	1992	31-20-08 31-21-09	53,900	M-R	35,341	32,938	61.10%		
1991	Fish Creek	Big Lake	1993	31-21-41	74,198	M-R	43,117	40,875	55.10%		
Eklutna Tailrace											
1996	Jim Creek	Ft Richardson	1998	31-26-27 31-26-54, 55,56	112,219	PC	112,219	111,882	99.70%		
1997	Jim Creek	Ft Richardson	1999	31-26-16	126,602	EC	44,073	42,663	33.70%		
1998	Jim Creek	Ft Richardson	2000	31-01-46	76,851	EC	40,514	40,149	52.24%		
1999	Eklutna Tailrace	Ft Richardson	2001	31-02-47	124,838	HI	43,713	43,494	34.84%		
2000	Eklutna Tailrace	Ft Richardson	2002	31-02-46	120,629	HI	44,518	44,295	36.72%	Cook Inlet	5H
2001	Eklutna Tailrace	Ft Richardson	2003		120,736	HI				Cook Inlet	5H

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					Total Released		Coded Wire Tagged			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged	Percent		Hatch
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Released	Released	Tagged	Mark Group	Code
Fish Creek											
1990	Fish Creek	Big Lake	1992	31-20-12	74,953	M-R	45,538	43,625	58.20%		
				31-20-13							
1991	Fish Creek	Big Lake	1993	31-21-40	67,934	M-R	44,050	43,257	63.70%		
Homer Spit											
1996	Bear Lake	Elmendorf	1998	31-26-28	130,219	M-R	42,057	41,926	32.20%		
1997	Bear Lake	Elmendorf	1999	31-01-40	129,602	M-R	44,405	43,020	33.19%		
	Bear Lake	Elmendorf/ Ft Richardson	2000-01 ^c								
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-01-36	100,280	HI	44,992	44,812	44.69%		
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-01-98	95,648	HI	45,498	44,179	46.19%	Cook Inlet	5H
2000	Bear Lake	Ft Richardson	2002		120,707	HI				Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003		222,935	HI				Cook Inlet	5H
Little Susitna at Houston											
1990	Little Susitna	Ft Richardson	1992	31-20-07	154,466	M-R	21,884	19,564	12.70%		
1991	Little Susitna	Ft Richardson	1993	31-21-37	148,282	M-R	21,404	20,312	13.70%		
Lowell Creek											
2000	Bear Lake	Ft Richardson	2002		119,512	HI				Resurrection Bay	4H
2001	Bear Lake	Ft Richardson	2003		124,389	HI				Resurrection Bay	4H
Nancy Lake											
1990	Little Susitna	Ft Richardson	1992	31-20-06	158,459	M-R	21,598	19,222	12.10%		
1991	Little Susitna	Ft Richardson	1993	31-21-37	131,591	M-R	21,001	19,930	15.20%		
1992	Little Susitna	Ft Richardson	1994	31-23-01	126,694	M-R	44,489	43,818	34.60%		
1993	Little Susitna	Ft Richardson	1995	31-23-39	151,985	M-R	46,261	45,245	29.80%		

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Brood		Release	Type of	Total Released		Coded Wire Tagged			Thermal Marking	
				Estimate	Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Year	Broodstock	Hatchery	Year	CWT Code						
Seward Lagoon										
2000	Bear Lake	Ft Richardson	2002		121,743	HI			Resurrection Bay	4H
2001	Bear Lake	Ft Richardson	2003		123,718	HI			Resurrection Bay	4H
Ship Creek^b										
1990	Ship Creek	Elmendorf	1992	31-19-63 31-20-01	67,178	PC	44,086	38,443	57.20%	
1991	Ship Creek	Elmendorf	1993	31-21-36	54,764	PC	42,112	41,322	75.50%	
1992	Ship Creek	Elmendorf	1994	31-23-04	75,779	PC	44,031	41,722	55.10%	
1993	Little Susitna	Ft Richardson	1995	31-23-38	158,981	M-R	45,491	44,654	28.10%	
1995	Little Susitna	Ft Richardson	1997	31-25-63	232,066	PC,HI	45,925	45,741	19.71%	
1996	Little Susitna	Ft Richardson	1998	31-26-53 31-26-26	232,765	HI	67,812	66,997	28.78%	
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-26-14 31-01-29	165,388	EC	48,299	45,380	27.44%	
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-01-32 31-01-33	260,070	EC	61,640	58,989	22.68%	
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-02-61	233,563	HI	64,165	61,663	26.40%	
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-02-83	212,639	HI	67,959	63,678	29.95%	Cook Inlet
2001	Ship Cr (Little Susitna)	Ft Richardson	2003	31-02-74, 31-02-69	234,716	HI	64,234	64,125	27.32%	Cook Inlet
Wasilla Creek										
1990	Fish Cr	Big Lake	1992	31-20-10 31-20-11	76,315	M-R	44,148	41,985	55.00%	
1991	Fish Cr	Big Lake	1992	31-21-42	77,174	M-R	43,001	41,711	54.10%	
1994	Little Susitna	Ft Richardson	1996	31-25-05	145,923	M-R	46,980	46,839	32.10%	

^a M-R is mark-recapture; PC is physical count; HI is hatchery inventory; EC is electronic count

^b Campbell and Ship creeks were combined and termed "Anchorage Urban Streams" in 1996.

^c Stocking continued, but releases did not contain tagged or thermally marked fish.

Appendix A2.-Historical releases of Chinook salmon that were adipose-clipped and tagged with coded wire tags, and/or thermally marked.

						Total Released		Coded Wire Tagging		Thermal Marking	
Brood Year	Broodstock	Hatchery	Release Year	CWT Code	Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Buskin River											
1994	Deception Cr	Elmendorf	1995	31-24-31	84,349	M-R	41,572	41,078	48.70%		
1995	Deception Cr	Elmendorf	1996	31-25-09	113,220	M-R	41,259	40,681	35.90%		
Crooked Creek											
1993	Crooked Cr	Elmendorf	1994	31-23-14	224,784	M-R	43,609	43,034	19.10%		
1994	Homer ^b	Elmendorf	1995	31-24-27	184,049	M-R	40,903	38,420	20.90%		
1995	Homer ^b	Elmendorf	1996	31-25-12	193,180	M-R	40,827	40,196	20.80%		
1996	Homer ^b	Elmendorf	1997	31-25-55	223,200	M-R	41,049	39,038	17.49%		
1997	Homer ^b	Elmendorf	1998	31-26-29	137,338	M-R	42,874	42,610	31.03%		
1998	Homer ^{b,c,d}	Elmendorf	1999	31-01-41	192,304	M-R	43,431	42,649	22.17%		
1999	Crooked Cr ^c	Elmendorf	2000	31-02-31, 31-01-34, 35	108,507	PC	108,507	105,578	97.30%		
2000	Crooked Cr ^c	Elmendorf	2001	31-01-95, 31-02-36, 37	109,201	PC	109,201	107,454	98.40%		
2001	Crooked Cr ^c	Elmendorf	2002	31-02-51, 31-01-96, 99	99,547	PC	99,547	98,452	98.90%	Crooked Cr	2,4H4 ^e
2002	Crooked Cr ^c	Ft Richardson	2003	31-02-72, 73, 68	98,800	PC	98,800	94,058	95.20%	Cook Inlet	2,3H

-continued-

Appendix A2.-Page 2 of 6.

					Total Released		Coded Wire Tagging			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged	Percent		Hatch
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Released	Released	Tagged	Mark Group	Code
Deception Creek											
1991	Deception Cr	Ft Richardson	1992	31-21-03	179,724	M-R	44,089	33,464	18.60%		
1992	Deception Cr	Ft Richardson	1993	31-21-60	160,194	M-R	42,782	39,420	24.60%		
1993	Deception Cr	Ft Richardson	1994	31-23-17	177,913	M-R	46,289	45,921	25.80%		
1994	Deception Cr	Ft Richardson	1995	31-24-34	184,740	M-R	46,807	46,256	25.00%		
1995	Deception Cr	Ft Richardson	1996	31-25-14	186,918	M-R	47,700	47,145	25.20%		
1996	Deception Cr	Ft Richardson	1997	31-26-03, 04, 05,06,07	209,644	PC	209,644	207,973	99.20%		
1997	Deception Cr	Ft Richardson	1998	31-25-32	197,392	PC	197,392	195,615	99.10%		
1998	Deception Cr	Ft Richardson	1999	31-26-17, 18, 19, 20 31-01-31	201,586	PC	201,586	199,722	99.08%		
1999	Deception Cr	Ft Richardson	2000	31-26-21, 31-01-44, 31-02-33, 34,35	206,496	PC	206,496	205,051	99.30%		
2000	Deception Cr	Ft Richardson	2001	31-02-41, 42,43,44,45	207,465	PC	207,465	204,560	98.60%		
2001	Deception Cr	Ft Richardson	2002	31-01-92, 31-02-52, 53,54,55	197,277	PC	197,277	196,608	99.66%	Deception Cr	2,5H
2002	Deception Cr	Ft Richardson	2003	31-02-70, 71, 31-01-94	101,181	PC	101,181	99,562	98.40%	Cook Inlet	2,3H
Eagle River											
1993	Ship Creek	Elmendorf	1994	31-23-13	98,872	M-R	43,612	41,669	42.10%		
Eklutna Tailrace											
2001	Ship Creek	Elmendorf	2002		106,991	VOL				Eklutna Tailrace	2,3H3
2002	Ship Creek	Ft Richardson	2003		218,492	HI				Cook Inlet	2,3H

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					Total Released		Coded Wire Tagging			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged	Percent		Hatch
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released	Fish Released	Tagged	Mark Group	Code
Fleming Spit											
1998	Deception Cr	Ft. Richardson	1999	31-26-23	49,773	PC	45,705	45,385	91.18%		
1999	Deception Cr	Elmendorf	2000	31-01-38	45,000	VIS	17,358	17,236	38.30%		
2000	Deception Cr	Elmendorf	2001	31-02-38	94,812	HI	40,659	40,415	42.63%		
2001	Deception Cr	Ft. Richardson	2002	31-02-57	109,656	HI	40,054	39,573	36.09%	Prince William Sound	2,4H
2002	Deception Cr	Ft. Richardson	2003		109,757	HI				Prince William Sound	2,4H
Halibut Cove											
1993	Crooked Creek	Elmendorf	1994	31-23-15	98,872	M-R	21,205	21,038	21.30%		
1994	Ninilchik River	Elmendorf	1995	31-24-30	37,577	M-R	36,944	36,700	97.70%		
1995	Ninilchik River	Elmendorf	1996	31-25-11	97,729	M-R	40,688	39,345	40.30%		
1996	Ninilchik River	Elmendorf	1997	31-25-58	78,133	M-R	40,919	39,487	50.54%		
1997	Ninilchik River	Elmendorf	1998	31-26-32	65,893	M-R	38,476	38,041	57.73%		
	Ninilchik River	Elmendorf	1999-01 ^f								
2001	Ninilchik River	Elmendorf	2002		106,279	VOL				Kachemak Bay	2,4H3
2002	Ninilchik River	Ft Richardson	2003		106,844	HI				Cook Inlet	2,3H
Homer Spit (early run)											
1993	Crooked Creek	Elmendorf	1994	31-23-16	163,963	M-R	26,003	25,615	15.60%		
1994	Homer ^b	Elmendorf	1995	31-24-32	216,026	M-R	41,650	40,291	18.70%		
1995	Homer ^b	Elmendorf	1996	31-25-07	204,085	M-R	40,868	39,017	19.10%		
1996	Homer ^b	Elmendorf	1997	31-25-60	217,773	M-R	41,112	38,810	17.82%		
1997	Homer ^b	Elmendorf	1998	31-26-33	177,730	M-R	40,012	39,652	22.31%		
1998	Homer ^b	Elmendorf	1999	31-01-45	163,170	M-R	42,561	40,423	24.77%		
	Ninilchik River	Elmendorf	2000-01 ^f								
2001	Ninilchik River	Elmendorf	2002		190,026	VOL				Kachemak Bay	2,5H3
2002	Ninilchik River	Ft Richardson	2003		206,292	HI				Cook Inlet	2,3H

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					Total Released		Coded Wire Tagging			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged	Percent		Hatch
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Released	Released	Tagged	Mark Group	Code
Homer Spit (late run)											
1992	Kasilof River	Crooked Creek	1994	31-23-19	56,920	M-R	22,612	22,383	39.30%		
1994	Homer ^g	Elmendorf	1995	31-24-33	123,048	M-R	41,054	40,466	32.90%		
1995	Homer ^g	Elmendorf	1996	31-25-13	108,204	M-R	40,615	38,787	35.80%		
1996	Homer ^g	Elmendorf	1997	31-25-61	100,933	M-R	41,028	39,264	38.90%		
1997	Homer ^g	Elmendorf	1998	31-26-34	112,100	HI	40,158	39,997	35.68%		
	Homer ^g	Elmendorf	1999 ^f								
Lowell Creek											
1996	Deception Cr	Elmendorf	1997	31-25-59	102,147	M-R	40,906	40,497	39.65%		
	Deception Cr	Elmendorf	1998-99 ^f								
	Crooked Creek	Elmendorf	2000-01 ^f								
2001	Crooked Creek	Elmendorf	2002		93,296	VOL				Resurrection Bay	2,5H3
2002	Crooked Creek	Ft Richardson	2003		110,331	HI				Resurrection Bay	2,5H
Ninilchik River											
1991	Ninilchik River	Ft Richardson	1992	31-21-04	132,387	M-R	43,648	41,335	31.20%		
1992	Ninilchik River	Ft Richardson	1993	31-21-59	184,585	M-R	44,487	42,960	23.30%		
1993	Ninilchik River	Ft Richardson	1994	31-23-18	201,513	M-R	46,193	45,535	22.60%		
1994	Ninilchik River	Ft Richardson	1995	31-24-35	54,662	PC	54,662	54,115	99.00%		
1995 ^c	Ninilchik River	Ft Richardson	1996	31-25-15	51,688	PC	51,588	50,866	98.60%		
1996 ^c	Ninilchik River	Ft Richardson	1997	31-26-08	50,698	PC	50,698	50,292	99.20%		
1997	Ninilchik River	Ft Richardson	1998	31-26-35	48,798	PC	48,798	47,480	97.30%		
1998	Ninilchik River	Ft Richardson	1999	31-01-45	49,853	PC	49,853	48,906	98.10%		
1999	Ninilchik River	Ft Richardson	2000	31-02-48	51,298	PC	51,298	50,016	97.50%		
2000	Ninilchik River	Ft Richardson	2001	31-02-60	54,770	PC	54,770	54,441	99.40%		
2001	Ninilchik River	Ft Richardson	2002	31-02-82	54,631	PC	54,631	54,139	99.10%	Ninilchik River	2,3H
2002	Ninilchik River	Ft Richardson	2003	31-02-56, 31-01-83	47,997	PC	47,997	44,349	92.40%	Cook Inlet	2,3H

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					Total Released		Coded Wire Tagging			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged	Percent		Hatch
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released	Fish Released	Tagged	Mark Group	Code
Seldovia											
1993	Crooked Creek	Elmendorf	1994	31-23-11	107,246	M-R	46,754	45,439	42.40%		
1994	Homer ^b	Elmendorf	1995	31-24-29	116,165	M-R	41,609	40,678	35.00%		
1995	Ninilchik River	Elmendorf	1996	31-25-10	118,274	M-R	40,667	39,610	33.50%		
1996	Ninilchik River	Elmendorf	1997	31-25-57	103,757	M-R	41,279	39,834	38.39%		
1997	Ninilchik River	Elmendorf	1998	31-26-31	69,461	M-R	40,654	40,125	57.77%		
	Ninilchik River	Elmendorf	1999-01 ^f								
2001	Ninilchik River	Elmendorf	2002		83,045	VOL				Kachemak Bay	2,4H3
2002	Ninilchik River	Ft Richardson	2003		107,521	HI				Cook Inlet	2.3H
Shakespeare Creek											
1998	Deception Cr	Ft Richardson	1999	31-26-24	49,797	PC	45,023	43,897	88.21%		
1999	Deception Cr	Elmendorf	2000	31-01-39	119,389	M-R	43,551	42,898	35.93%		
Ship Creek											
1993	Ship Creek	Elmendorf	1994	31-23-12	199,830	M-R	44,138	42,864	21.50%		
1994	Ship Creek	Elmendorf	1995	31-24-28	218,487	M-R	40,764	38,570	17.70%		
1995	Ship Creek	Elmendorf	1996	31-25-08	231,444	M-R	41,221	40,109	17.30%		
1996	Ship Creek	Elmendorf	1997	31-25-56	326,371	M-R	40,522	40,319	12.36%		
1997	Ship Creek	Elmendorf	1998	31-26-30	204,741	M-R	42,073	41,565	20.30%		
1998	Ship Creek	Elmendorf	1999	31-01-42	197,168	M-R	44,265	42,262	21.44%		
	Ship Creek	Elmendorf	2000-01 ^f								
2001	Ship Creek	Elmendorf	2002		290,501	VOL				Ship Creek	2,4H4
2002	Ship Creek	Ft Richardson	2003		329,416	HI				Cook Inlet	2,3H
Valdez Glacier Stream											
1998	Deception Cr	Ft Richardson	1999	31-26-22	49,353	PC	46,528	45,923	93.05%		
1999	Deception Cr	Elmendorf	2000	31-01-37	115,582	M-R	41,728	41,060	35.52%		

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						Total Released		Coded Wire Tagging		Thermal Marking	
Brood		Release		Type of		Clipped		Tagged		Percent	
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released	Fish Released	Tagged	Mark Group	Hatch Code
Valdez Harbor											
2000	Deception Cr	Elmendorf	2001	31-02-39	94,701	HI	44,418	43,974	46.43%		
2001	Deception Cr	Ft Richardson	2002	31-02-58	107,861	HI	43,833	42,650	39.54%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,661	HI				Prince William Sound	2,4H
Whittier Harbor											
2000	Deception Cr	Elmendorf	2001	31-02-40	95,823	HI	42,800	42,458	44.31%		
2001	Deception Cr	Ft Richardson	2002	31-02-59	109,763	HI	45,854	44,799	40.81%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,700	HI				Prince William Sound	2,4H

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^a M-R is mark-recapture; PC is physical count; HI is hatchery inventory, VIS is a visual estimate, VOL is volumetric estimate.

^b Homer (Crooked Creek).

^c Adjusted for holding mortality before release.

^d Corrections for release numbers reported in the 1999 report.

^e Release group missed last temperature decrease during thermal marking. Should have had hatch code of 2,4H5.

^f Stocking continued, but releases did not contain tagged or thermally marked fish.

^g Homer (Kasilof River).